

## CLAIMS

What is claimed is:

1. A process for manufacturing a catalyst coated membrane comprising:

- 5           (a) applying at least one electrocatalyst coating composition to an element comprising a polymer membrane having a first and a second surface, and a first dimensionally stable temporary substrate, wherein the coating composition is applied to at least portions of the first surface of the polymer membrane;
- 10           (b) drying the electrocatalyst coating composition to form at least one first electrode on the polymer membrane of the element;
- 15           (c) applying a second dimensionally stable temporary substrate to the at least one first electrode formed in step (b);
- (d) removing the first dimensionally stable temporary substrate from the polymer membrane;
- 20           (e) applying at least one electrocatalyst coating composition to at least a portion of the second surface of the polymer membrane; and
- (f) drying the electrocatalyst coating composition on the polymer membrane to form a sandwich comprising the at least one second electrode, the polymer membrane, the at least one first electrode and the second dimensionally stable temporary substrate.
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2. The process of Claim 1 wherein the element is prepared by applying a first dimensionally stable temporary substrate to the polymer membrane.

- 30           3. The process of Claim 2 wherein the applying is by lamination.
4. The process of Claim 1 further comprising:
- (g) removing the second dimensionally stable temporary substrate to form a catalyst coated membrane comprising a polymer membrane sandwiched between the at least one first and second electrodes.
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5. The process of Claim 1 wherein the electrocatalyst coating composition comprises an electrocatalyst, an ion exchange polymer and a liquid medium.

6. The process of Claim 5 wherein the ion exchange polymer is perfluorinated.

7. The process of Claim 2 wherein the electrocatalyst coating composition further comprises fluorinated polymer.

5 8. The process of Claim 7 wherein the fluorinated polymer is a PTFE fibril.

9. The process of Claim 1 wherein the applying at least one electrocatalyst coating composition is accomplished by flexographic printing.

10 10. The process of Claim 1 wherein the application of the electrocatalyst coating composition and drying steps are repeated to form multiple electrode layers covering the same part of the surface of the membrane.

15 11. The process of Claim 1 wherein the application of the electrocatalyst coating composition and drying steps are repeated to form multiple electrode layers that vary in composition among said multiple layers.

20 12. The process of Claim 1 wherein the application of the electrocatalyst coating composition and drying steps provide an electrode layer with a predetermined nonuniform distribution of electrocatalyst across the electrode layer.

25 13. The process of Claim 1 further comprising applying at least one nonelectrocatalytic coating composition to form a nonelectrocatalytic layer over at least part of the same area of the substrate which is covered by an electrode layer.

14. The process of Claim 13 wherein said nonelectrocatalytic layer is an abrasion-resistant coating covering said electrode layer.

15. The process of Claim 13 wherein said nonelectrocatalytic layer is a sealant covering said electrode layer.

30 16. The process of Claim 1 wherein electrocatalyst coating composition applied onto the opposite surface of the polymer membrane to form the second electrode is in registration with the first electrode on the first surface.

35 17. The process of Claim 16 wherein catalyst coating composition applied to the first surface is different from that applied to the second surface of the polymer membrane.

18. The process of Claim 1 wherein the applying in steps (c) or (e), or both is by lamination.

19. The process of Claim 1 wherein the removing in step (d) is by peeling.

20. The process of Claim 1 wherein drying is conducted at ambient temperatures.

5        21. The process of Claim 1 wherein the first and second dimensionally stable substrates are selected from the group consisting of temporary substrate is selected from the group consisting of polyesters; polyamides, polycarbonates, fluoropolymers, polyacetals, polyolefins, and polyimides.

10        22. The process of Claim 21 wherein the first, second or both dimensionally stable substrates is polyester.

23. A fuel cell comprising a catalyst coated membrane prepared by a process comprising:

- 15            (a) applying at least one electrocatalyst coating composition to an element comprising a polymer membrane having a first and a second surface, and a first dimensionally stable temporary substrate, wherein the coating composition is applied to at least portions of the first surface of the polymer membrane;
- 20            (b) drying the electrocatalyst coating composition to form at least one first electrode on the polymer membrane of the element;
- 25            (c) applying a second dimensionally stable temporary substrate to the at least one first electrode formed in step (b);
- 30            (d) removing the first dimensionally stable temporary substrate from the polymer membrane;
- (e) applying at least one electrocatalyst coating composition to at least a portion of the second surface of the polymer membrane; and
- 35            (f) drying the electrocatalyst coating composition on the polymer membrane to form a sandwich comprising the at least one second electrode, the polymer membrane, the at least one first electrode and the second dimensionally stable temporary substrate.

24. The fuel cell of Claim 23 wherein the process for preparing the catalyst coated membrane further comprises:

- (g) removing the second dimensionally stable temporary substrate to form a catalyst coated membrane comprising a polymer membrane sandwiched between the at least one first and second electrodes

5           25. The fuel cell of Claim 23 wherein the element is prepared by applying a first dimensionally stable temporary substrate to the polymer membrane.

          26. The fuel cell of Claim 25 wherein the applying is by lamination.

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